

# U.S. GEOLOGICAL SURVEY TOPOGRAPHIC MAPS

**Objective:** To learn the features of standard U.S. Geological Survey topographic maps.

**Materials:** A complete USGS topographic quadrangle is helpful, but not required.

**Reference:** McKnight and Hess, *Physical Geography*, 8th ed., pp. A3–A7.

## TOPOGRAPHIC MAPS

**Topographic maps** are large-scale maps that use contour lines to portray the elevation and shape of the topography. Topographic maps show and name both natural and human-made features. The U.S. Geological Survey (USGS) is the principal government agency that provides topographic maps of the United States. USGS topographic maps cover the entire United States at several different scales.

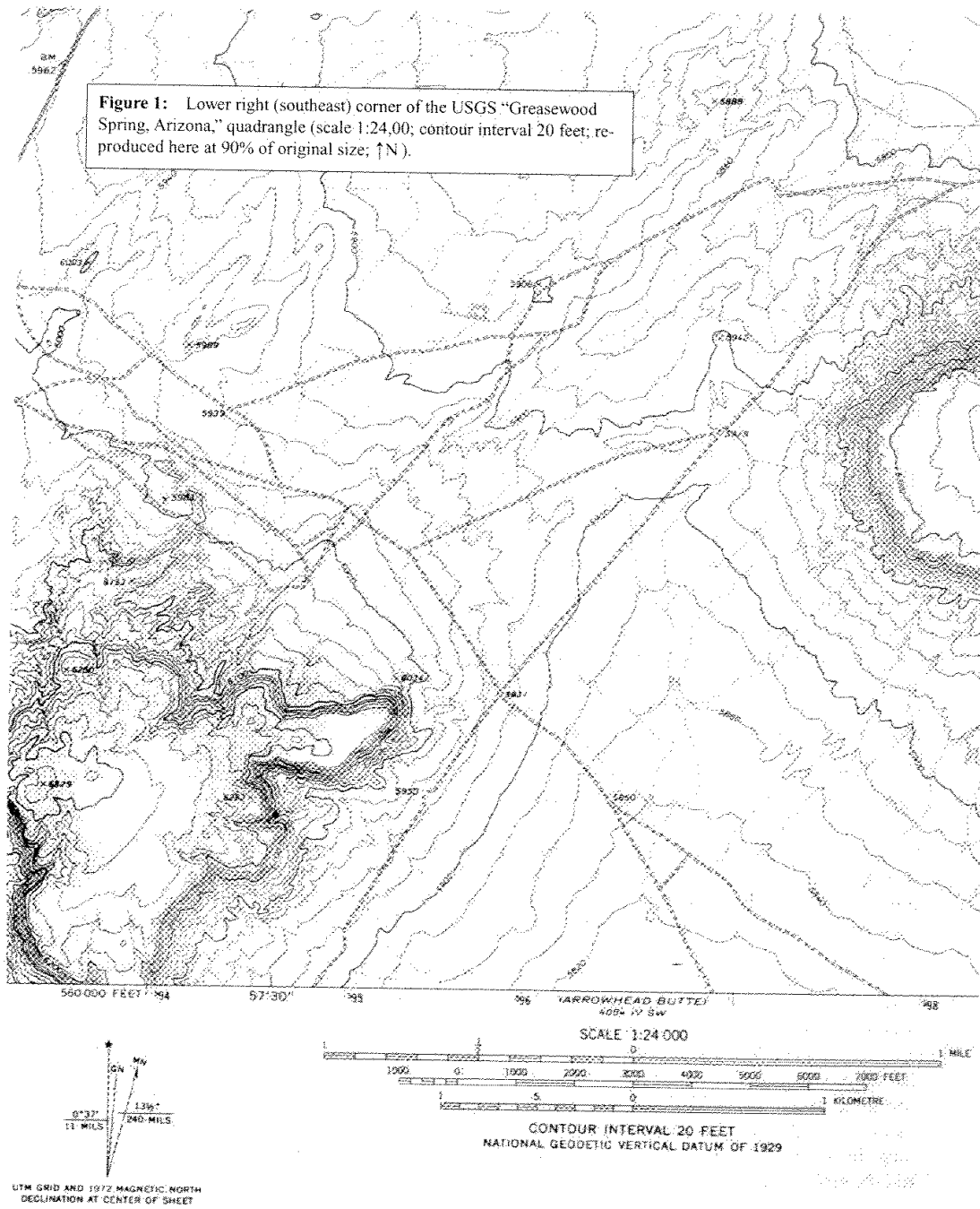
The largest scale maps are those at a scale of 1:24,000 (1" represents 2000'; 1 cm represents 0.24 km). The long-established 1:62,500 scale maps (1" represents about 1 mile; 1 cm represents about 0.6 km) have been replaced by 1:100,000 scale maps (1" represents about 1.6 miles; 1 cm represents 1 km). The entire country is also mapped at a scale of 1:250,000 (1" represents about 4 miles; 1 cm represents 2.5 km). The primary scale for mapping Alaska remains 1:63,360 (1" represents 1 mile; 1 cm represents 0.63 km), although larger scale maps will eventually cover this entire state as well.

## MARGINAL DATA ON USGS MAPS

In this exercise we will focus primarily on the information found in the margins of these maps (this information has been omitted from most of the maps reproduced for future exercises). Figure 1 shows the lower right corner of a standard USGS topographic map with a scale of 1:24,000 (sometimes referred to as a "7½ minute" map). (The map has been reproduced here at 90% of its original size in order to fit on a two-page spread in the Lab Manual.)

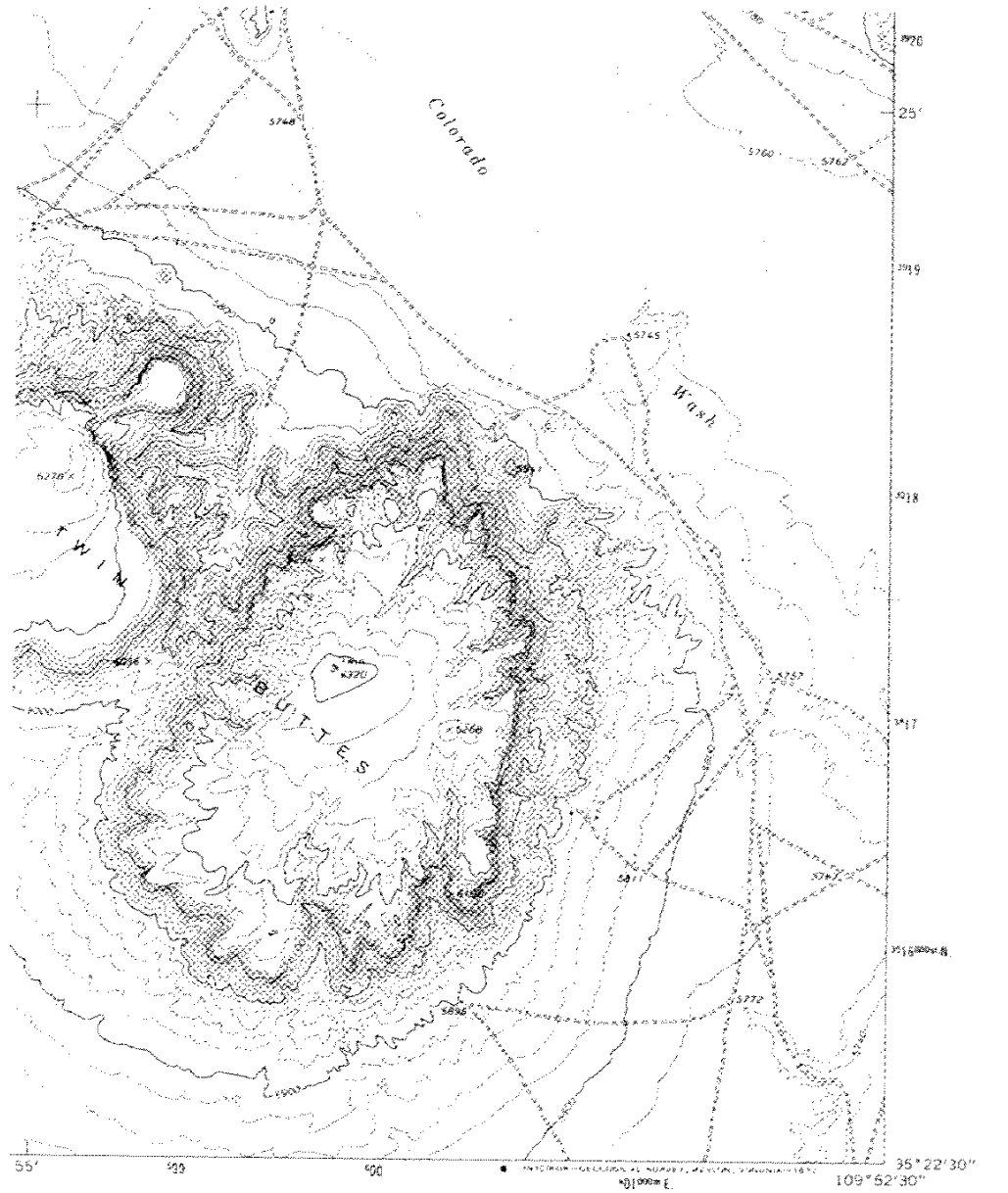
The name of this map, or **quadrangle**, is "Greasewood Spring, Arizona." Below the name is the date of publication, in this case, 1972. The date of any revisions would also be listed here. To the left of the name, is a small map showing the quadrangle location in Arizona.

The latitude and longitude are printed at each corner of the quadrangle. The coordinates of the lower right (southeast) corner of this map are 35°22'30" N latitude, 109°52'30" W longitude (on these maps, "north" latitude and "west" longitude are understood). Below the name, notice that quadrangles are also identified by the latitude and longitude of the lower right corner of the map, in this case, "N3522.5—W10952.5/7.5" (35°22.5' N latitude; 109°52.5' W longitude; 7.5 minute series map).



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS  
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092  
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

U.S. Geological Survey Topographic Maps



ROAD CLASSIFICATION

Primary highway, hard surface	Light-duty road, hard or improved surface
Secondary highway, hard surface	Unimproved road
Interstate Route	U. S. Route
	State Route

GREASEWOOD SPRING, ARIZ.  
N 35° 22.5' - W 109° 52.5' / 7.5'

1972

BETTY WELLS  
1984 10 92

The eight adjacent quadrangles are named in parentheses around the margins of the map. The quadrangle to the southeast of Greasewood Spring is called "Betty Well." In some cases, the eight adjacent quadrangles are shown with a small diagram at the bottom of the map.

The scales are shown at the bottom center of the map. Below the fractional scale (1:24,000), three graphic scales are shown, in miles, feet, and kilometers. Note that "0" is not at the far left edge of the graphic scales. Below the scales the contour interval is given. The **datum** is the reference point from which elevations are measured. On USGS topographic maps the datum is normally mean sea level.

The **declination arrow** is found at the lower left corner of the map. True north is shown with the tallest arrow, labeled with either a star or a large "N." The "MN" arrow shows the direction of **magnetic north**. The location of the north magnetic pole is not the same as the true geographical North Pole, so it is necessary to adjust for this difference when using a magnetic compass. The position of the north magnetic pole changes with time, and so the compass correction indicated on the map may not be exact some years after the original survey.

The "GN" arrow shows **grid north**. In addition to the grid system of latitude and longitude, other kinds of grids are also marked on many topographic maps. Grid north refers to the orientation of the **Universal Transverse Mercator grid** (UTM) used by the military. Abbreviated numbers for the UTM grid are marked every 1000 or 10,000 meters around the margins of the map. North-south locations are indicated in meters north or south of the equator, while east-west locations are indicated in meters from a standard meridian. Similar state grids are often marked every 1000 or 10,000 feet.

UTM grid numbers are shown along the right and bottom margins of the map. Along the right margin of the map, the number  $^{39}16^{000m}N$  indicates a location 3,916,000 meters north of the equator, while along the bottom margin of the map, the number  $^{60}1^{000m}E$  indicates a location 601,000 meters east of a standard meridian.

In addition to the UTM numbers along the margins of the map, additional indications of latitude and longitude are also provided. Notice along the right margin of the map, near the top of Figure 1, the number 25' appears—this marks the location where the latitude is 35°25' N. Along the bottom margin of the map, near the left side of Figure 1, you see the number 57'30"—this marks the location where the longitude is 109°57'30" W. Most topographic maps will have these supplementary marks for latitude and longitude at regular intervals along the margins.

## TOPOGRAPHIC MAP SYMBOLS

Standard symbols and colors are used on USGS topographic maps. Brown lines are elevation contours. Spot elevations are shown by black numbers next to an "X," while more precisely surveyed points known as **benchmarks** are shown as numbers next to the letters "BM." Blue lines and numbers are used to show water features (blue contour lines on a white background indicate glaciers). Green is used for various kinds of vegetation or forest cover. Human-built features, such as roads, are shown in black and red, while urbanized areas are shown with either red or gray shading. "Photorevised" features are shown in purple on maps that have been updated with aerial photographs. A chart showing standard symbols used on USGS topographic maps is found on the inside of the back cover of the Lab Manual.

U.S. Geological Survey Topographic Maps

Name \_\_\_\_\_

Section \_\_\_\_\_

**PROBLEMS**

The following questions are based on the lower right (southeast) corner of the "Greasewood Spring, Arizona," quadrangle (Figure 1):

1. What is the contour interval of the map? \_\_\_\_\_ feet
2. What is the difference in elevation between index contours? \_\_\_\_\_ feet
3. What is the elevation of the bench mark at the top of the eastern Twin Butte? \_\_\_\_\_ feet
4. Estimate (to the nearest half-minute [30"] the latitude of the bench mark at the top of the eastern Twin Butte: \_\_\_\_\_
5. What do the dashed double lines represent?
6. What is the name of the adjacent quadrangle to the south? \_\_\_\_\_
7. The latitude of the upper right (northeast) corner of the map is  $35^{\circ}30'$  N, while the longitude of the lower left (southwest) corner of the map is  $110^{\circ}00'$  W. Why is this called a "7.5 minute" topographic map?
8. At the time this quadrangle was printed, what was the difference (in degrees) between true north and magnetic north for this map? \_\_\_\_\_ degrees

U.S. Geological Survey Topographic Maps

9. On all three graphic scales for the map, "0" is not at the far left. Explain the reason for this.
10. Using the graphic map scales, determine the maximum width of the eastern Twin Butte (use the 6100' contour to be the outer edge of the butte):

\_\_\_\_\_ feet

\_\_\_\_\_ kilometers

# U.S. PUBLIC LAND SURVEY SYSTEM

**Objective:** To learn to use the Public Land Survey System.

## PUBLIC LAND SURVEY SYSTEM

The **Public Land Survey**, or **township grid**, was established by the federal government in 1785 in order to keep track of land ownership in the American frontier. This grid covers most of the continental United States west of the Mississippi and Ohio Rivers, with the exception of some regions such as those under old Spanish land grants.

The starting point for the grid is a series of parallels known as **base lines**, and a series of **principal meridians** (Figure 1). Beginning at the intersection of a base line and a principal meridian, rows of 36 square-mile tracts of land known as **townships** were established (Figure 2a).

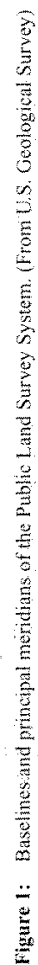
## TOWNSHIP AND RANGE

Each township is a square tract of land, six miles to a side, and is identified by its position north or south of a base line, and east or west of a principal meridian. The first position north of a base line is called “Township 1 North” (T1N), the second position north is T2N, and so on. The first position south is T1S.

The first position west of a principal meridian is called “Range 1 West” (R1W), and the first position east is R1E. Each 36 square-mile township is identified by both a **township** and a **range**. For example, one of the townships would be designated “Township 3 North, Range 2 East” (see Figure 2a).

(Note: the term “township” has two meanings in the context of the Public Land Survey—a 36-square mile tract of land, as well as the positions of these tracts north and south of a base line. It may help to think of “T1N” and “T2N” as referring to “Tier” 1 North, “Tier” 2 North, and so on.)

A township is divided into 36 **sections**. Each section is one square-mile (640 acres) in area and is given a number, from 1 to 36. Notice the specific numbering pattern of sections within a township (Figure 2b). Each section is subdivided into “quarter sections” (160 acres), and each quarter section is further divided into “quarters of quarter sections” (40 acres), or as shown in Figure 2c, into even smaller tracts of land. The shaded 10-acre plot shown in Figure 2c would be called the “Southeast Quarter of the Southwest Quarter of the Northeast Quarter, Section 24, Township 2 South, Range 3 West” ( $SE\frac{1}{4}, SW\frac{1}{4}, NE\frac{1}{4}, Sec. 24, T2S, R3W$ ).

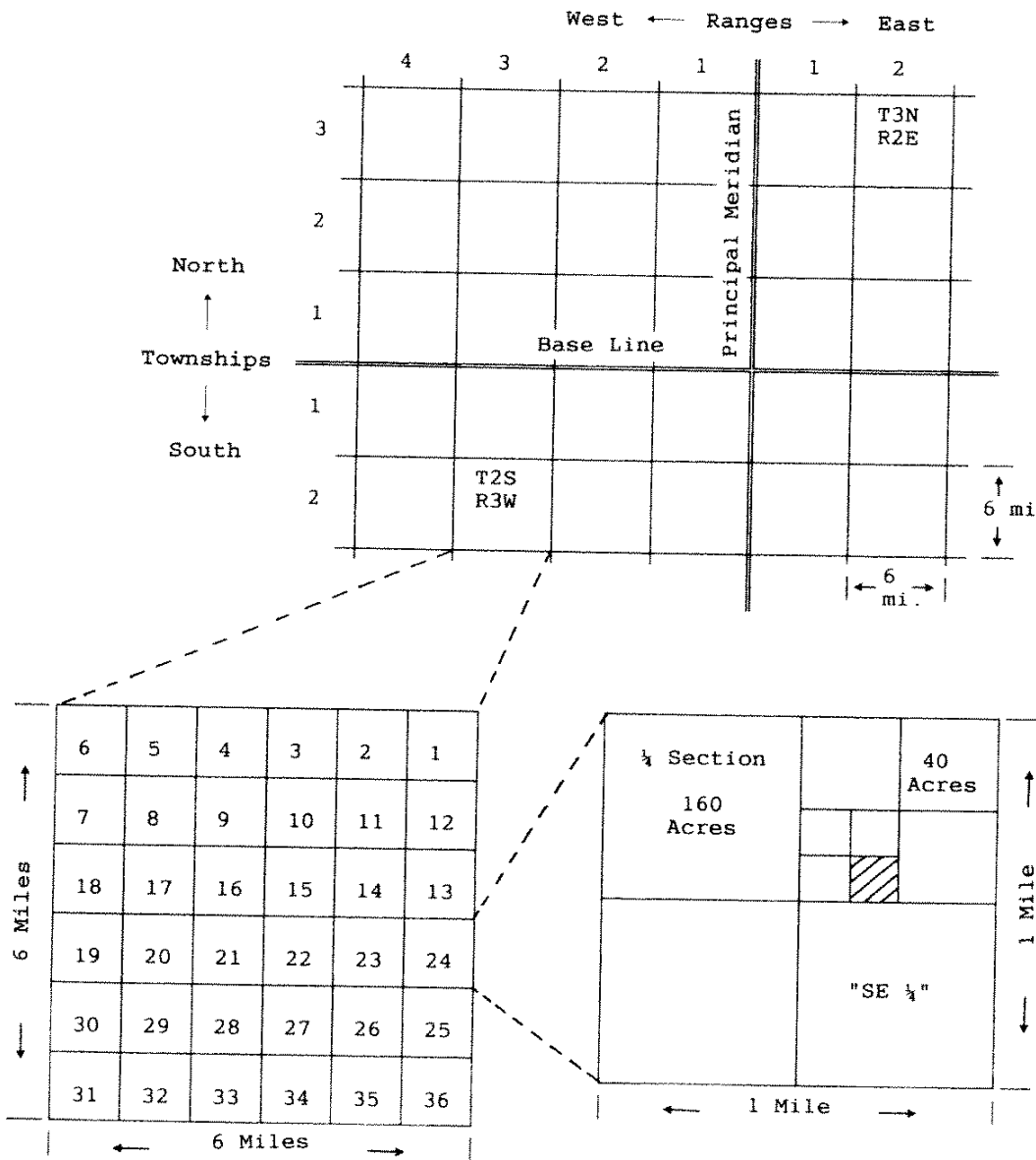


**Figure 1:** Baselines and principal meridians of the Public Land Survey System. (From U.S. Geological Survey)



Figure 2: Public Land Survey System.

(a) Township & Range Grid



(b) One "Township"

(c) One "Section"

## U.S Public Land Survey System

### **TOWNSHIP GRID ON TOPOGRAPHIC MAPS**

On USGS topographic maps, the public land survey grid is usually shown with red lines and section numbers (for example, look at Map T-11, the “Whitewater, Wisconsin,” quadrangle). The township and range numbers are shown along the margins of the map. The base line and principal meridian are often not identified. You will also notice that a row of townships is occasionally offset relative to the row to the north or south. This is to compensate for the constriction of a township that would result from the convergence of the meridians as latitude increases.

Name \_\_\_\_\_

Section \_\_\_\_\_

### PROBLEMS

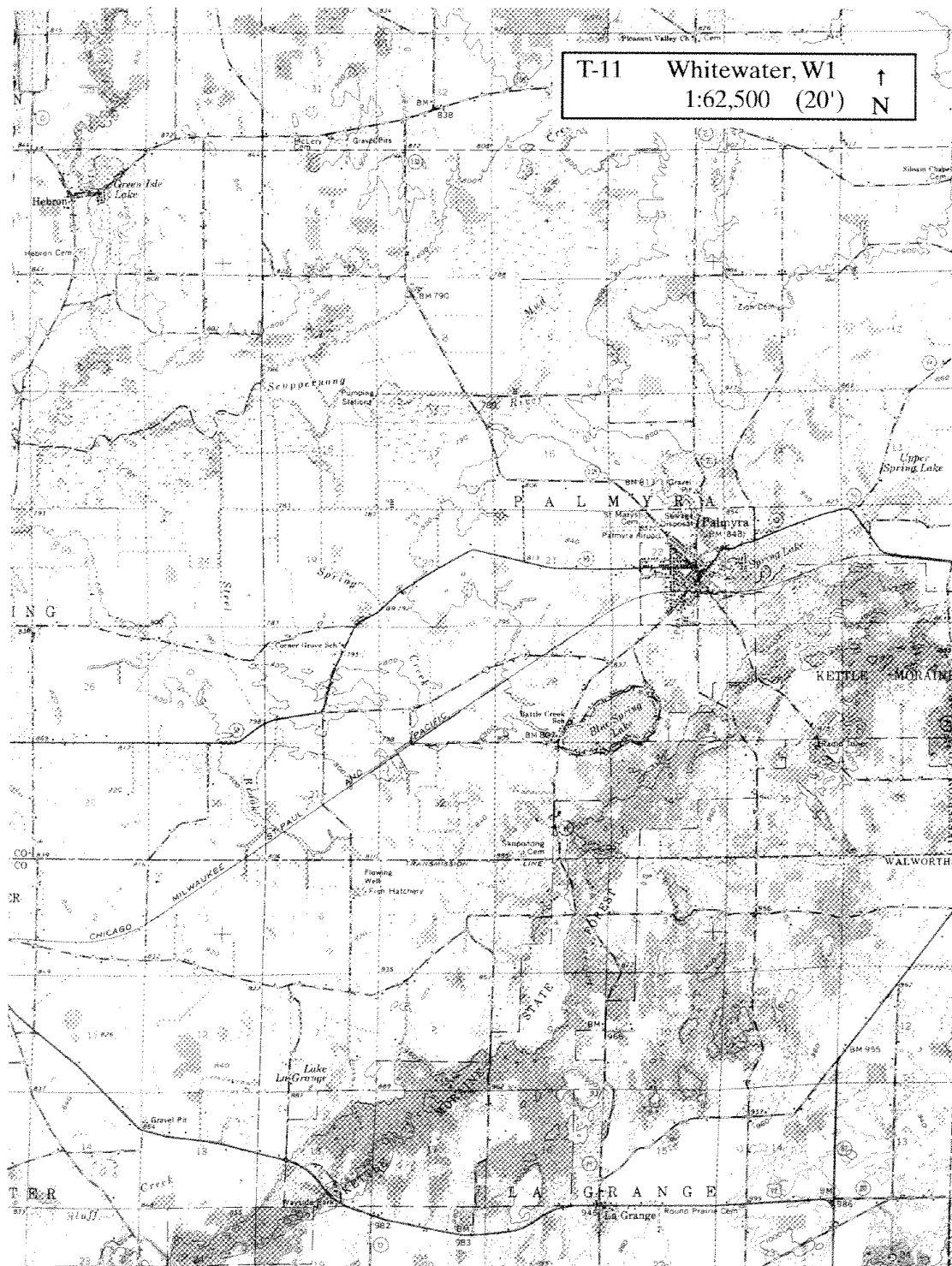
The following questions are based on Figure 3 on the following page, showing a portion of the "Antelope Peak, Arizona," quadrangle (scale 1:62,500; contour interval 25 feet). The map's marginal information is visible along the left and top margins ("T.5S," "R.2E," etc.). On the original USGS map, this information was printed in red.

1. The word "Hidden" appears on the map within which township?  
Township \_\_\_\_\_, Range \_\_\_\_\_
2. The words "Vekol Wash" appear within which township?  
Township \_\_\_\_\_, Range \_\_\_\_\_
3. The "Booth Hills" are found within which section and township?  
Section \_\_\_\_\_, Township \_\_\_\_\_, Range \_\_\_\_\_
4. Find the hill in Sec. 8, T6S, R2E. This hill covers approximately how many acres? \_\_\_\_\_ acres
5. With a red pencil, carefully mark off and shade in:
  - (a) The Northeast Quarter of Section 25, T5S, R1E.
  - (b) The Northwest Quarter of the Southeast Quarter of Section 5, T6S, R2E.
6. Describe two kinds of human/cultural features that follow the Public Land Survey grid.

3550 117  
(MOBILE)

This is a detailed topographic map of the Maricao National Forest area in Puerto Rico. The map features a grid with latitude and longitude coordinates. Key geographical features include the Maricao Mountains, the Hico River, and the Vekol River. Place names such as Hico, Maricao, and Vekol are clearly marked. The map also shows various roads, trails, and elevation contours. The title 'MARICAO NATIONAL FOREST' is prominently displayed in the center. The map is oriented with North at the top.

**Figure 3:** USGS “Antelope Peak, Arizona,” quadrangle (scale 1:62,500; contour interval 25 feet; ↑N).



**US Public Land Survey**

- A. Use the San Bernardino North Quad map to find the Township, Range and Section for the following features:

Feature	Township	Range	Section
1. Lake Gregory (NE)	<i>T 2 N</i>	<i>R 4 W</i>	<i>23</i>
2. Arrowhead Peak (E)	_____	_____	_____
3. West Fork Cable Canyon (NW)	_____	_____	_____

Notice that a large section of the map does not provide the Township and Range information. This does not mean that you can't determine these locations Township and Range. The cartographer provided enough information in other areas of the map for you to determine the Township and Range for anywhere on the map. So using the information provided, determine the Township, Range, and Section of the following two locations. Yes you have to do a little bit more investigative work to answer these questions : - )

4. Pennsylvania School (SW) \_\_\_\_\_
5. Newmark School (Center) \_\_\_\_\_
6. Look at either Highland Avenue or Waterman Avenue. What did the city planners utilize to create these major streets?

- B. Each section can be further divided into "quarters". Use the figure below to identify the subdivisions within each section.

1. (A) *S  $\frac{1}{2}$  of NW  $\frac{1}{4}$*
2. (B)
3. (C)
4. (D)
5. (E)

